31) $y+\ln xy=1$

$$\frac{dy}{dx}+\left(\frac{1}{xy}\left(\left(x\frac{dy}{dx}\right)+(1y)\right)\right)=0$$

$$\frac{dy}{dx}=-\left(\frac{1}{xy}\left(\left(x\frac{dy}{dx}\right)+(y)\right)\right)$$

$$\frac{dy}{dx}=-\frac{x\frac{dy}{dx}}{xy}+-\frac{y}{xy}$$

$$\frac{dy}{dx}+\frac{1}{y}\frac{dy}{dx}=\frac{-1}{x}$$

$$\frac{dy}{dx}\left(1+\frac{1}{y}\right)=\frac{-1}{x}$$

$$xy\left(\frac{dy}{dx}=-\frac{\left(\left(x\frac{dy}{dx}\right)+(y)\right)}{(xy)}\right)xy=xy\left(\frac{dy}{dx}\right)=-\left(x\frac{dy}{dx}\right)+(y)$$

$$\frac{xy\left(\frac{dy}{dx}\right)}{\left(\frac{dy}{dx}\right)}=-\frac{\left(\left(x\frac{dy}{dx}\right)+(y)\right)}{\left(\frac{dy}{dx}\right)}=xy=\frac{-\left(x\frac{dy}{dx}\right)-(y)}{\frac{dy}{dx}}$$

$$xy=-(x)-\left(\frac{y}{\frac{dy}{dx}}\right)\frac{dy}{dx}(x+xy)=\left(\frac{y}{\frac{dy}{dx}}\right)\frac{dy}{dx}$$

$$+(x)\quad+(x)$$

$$\frac{\left(\frac{dy}{dx}\right)(x+xy)}{(x+xy)}=\frac{-y}{(x+xy)}$$

$$\frac{dy}{dx}=\frac{-y}{x(1+y)}$$

$\ln(x\tan(y)) = \frac{1}{x\tan(y)} \cdot \left((1\tan y) + (x)\sec^2(y)\left(\frac{dy}{dx}\right)\right) = \frac{dy}{dx}$

$$\frac{\tan(y) + (x)\sec^2(y)\left(\frac{dy}{dx}\right)}{(x\tan(y))} = \frac{dy}{dx}$$

$$\left(\frac{\cos y}{1}\right)\frac{\frac{\sin y}{\cos y} + \frac{x}{\cos y}\left(\frac{dy}{dx}\right)}{x\frac{\sin y}{\cos y}}\left(\frac{\cos y}{1}\right) = \frac{dy}{dx}$$

$$\cancel{(x\sin(y))}\frac{\sin(y) + \frac{x}{\cos(y)}\left(\frac{dy}{dx}\right)}{\cancel{(x\sin y)}} = \frac{dy}{dx}(x\sin y)$$

$$\sin y + \frac{x}{\cos(y)}\left(\frac{dy}{dx}\right) = \frac{dy}{dx}(x\sin y)$$

$$-\frac{x}{\cos y}\left(\frac{dy}{dx}\right) \qquad -\frac{x}{\cos y}\left(\frac{dy}{dx}\right)$$

$$\frac{\sin y}{\left(x\sin(y) - \frac{x}{\cos y}\right)} = \frac{\frac{dy}{dx}\left(x\sin(y) - \frac{x}{\cos(y)}\right)}{\left(x\sin y - \frac{x}{\cos y}\right)}$$

$$\frac{\sin y}{x\sin(y) - \frac{x}{\cos(y)}} = \frac{dy}{dx}$$

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$$y=\frac{e^x-e^{-x}}{e^x+e^{-x}}$$

$$\frac{dy}{dx}=\frac{\left(e^x(1)-e^{-x}(-1)\right)\left(e^x+e^{-x}\right)-\left(\left(e^x-e^{-x}\right)\left(e^x+e^{-x}(-1)\right)\right)}{\left(e^x+e^{-x}\right)^2}$$

$$(e^x+e^{-x})(e^x+e^{-x})=e^{2x}+e^0+e^0+e^{-2x}$$

$$(e^x-e^{-x})(e^x-e^{-x})=e^{2x}-e^0-e^0+e^{-2x}$$

$$\frac{\left(e^{2x}+e^0+e^0+e^{-2x}\right)-\left(e^{2x}-e^0-e^0+e^{-2x}\right)}{(e^x+e^{-x})^2}$$

$$\frac{\cancel{e^{2x}}+1+1+\cancel{e^{-2x}}-\cancel{e^{2x}}+1+1-\cancel{e^{-2x}}}{(e^x+e^{-x})^2}=\frac{4}{(e^x+e^{-x})^2}$$

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$$\frac{d}{dx}\left(\ln\left(\frac{x^2\sin x}{\sqrt{1+x}}\right)\right) = \frac{\sqrt{1+x}}{x^2\sin x}\left(\frac{d}{dx}\,\frac{x^2\sin x}{\sqrt{1+x}}\right)$$

$$= \frac{\sqrt{1+x}}{x^2\sin x}\left(\frac{[2x\sin x + x^2\cos x]\sqrt{1+x} - x^2\sin x\left[\frac{1}{2\sqrt{1+x}}\right]}{(\sqrt{1+x})^2}\right)$$

$$\frac{1}{\left(\frac{1}{x}\right)} = x$$

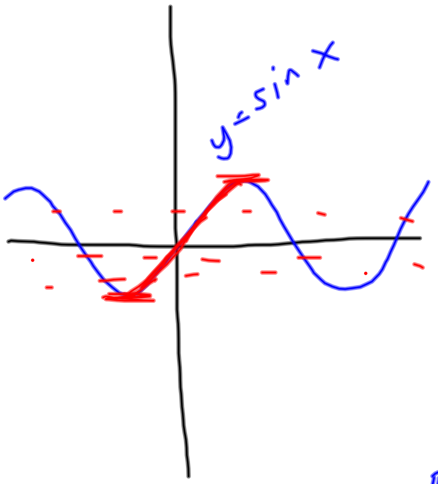
$$\frac{1}{\left(\frac{a}{b}\right)} = \frac{b}{a}$$

$$= \frac{1}{x^2\sin x\sqrt{1+x}}\left(2x\sin x\sqrt{1+x} + x^2\cos x\sqrt{1+x} - \frac{x^2\sin x}{2\sqrt{1+x}}\right)$$

$$= \frac{x}{x^2\sin x}\left(\frac{2\sin x\sqrt{1+x}}{\sqrt{1+x}} + \frac{x\cos x\sqrt{1+x}}{\sqrt{1+x}} - \frac{x\sin x}{2\sqrt{1+x}\sqrt{1+x}}\right)$$

$$= \frac{1}{x\sin x}\left(2\sin x + x\cos x - \frac{x\sin x}{2(1+x)}\right)$$

4.4 Inverse Trig Functions



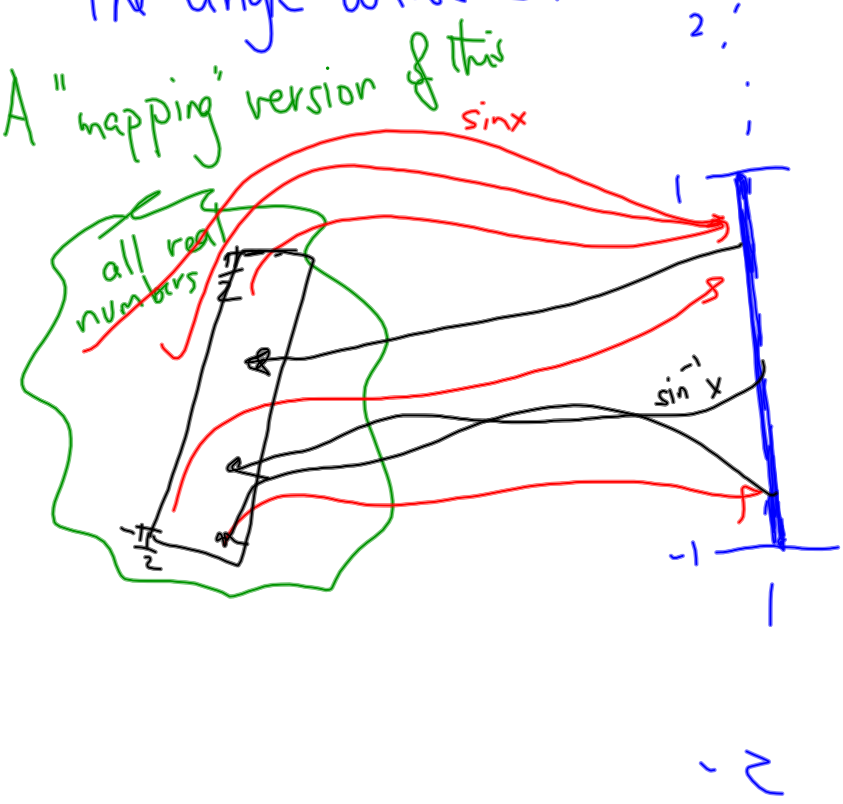
to "make" sin x invertible, consider the restricted domain $\left[\frac{-\pi}{2}, \frac{\pi}{2}\right]$.

call that fn $y = \text{Sin}(x)$

Its inverse $\left[\sin^{-1}(x) \text{ or } \arcsin(x)\right]$, then is

"The angle whose Sin = a number"

A "mapping" version of this



Inverse Trig Functions

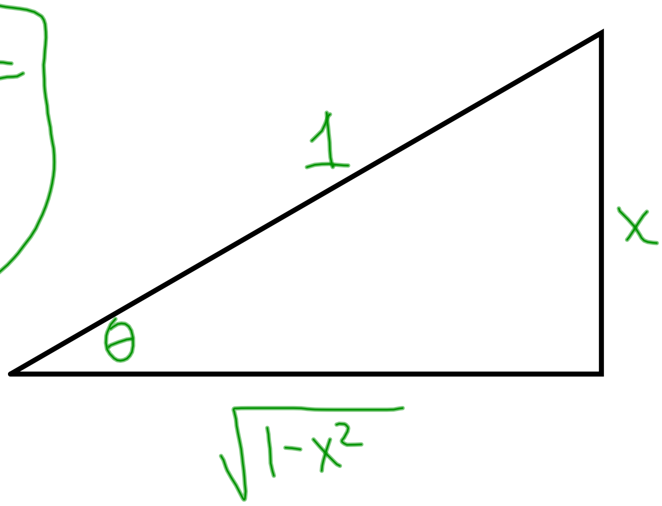
A technique

Can we determine $\cos(\sin^{-1}(x))$?

What is $\sin^{-1}(x)$?

Yes, $\sin^{-1}(x)$ is the angle whose sine is x.

$$\boxed{\cos(\sin^{-1}(x)) = \sqrt{1-x^2}}$$



So $\cos\theta = \dfrac{\sqrt{1-x^2}}{1} = \sqrt{1-x^2}$